Decision Making as a Function of Delusion Proneness

Senior Research Thesis

Presented in partial fulfillment of the requirements for graduation with research distinction in Psychology in the undergraduate colleges of The Ohio State University

by

Meisha Runyon

The Ohio State University

March 26, 2018

Project Advisor: Associate Professor Melissa T. Buelow, Department of Psychology

Abstract

Delusion proneness is an individual-differences characteristic, existing on a continuum from no delusional thoughts to a diagnosis of delusional disorder or schizophrenia. Previous research found delusion prone individuals are faster at making decisions and request less information to make them, potentially making a decision without sufficient information (jumping to conclusions). On the other hand, some research suggests that delusion prone individuals have a data gathering deficit rather than a problem with decision making. To date, most research in this area relied on use of a probabilistic reasoning task, and the ability to make advantageous decisions on other tasks has not been adequately examined. The present study examined risky decision making in individuals high and low in delusion proneness. Undergraduate student participants (n = 76) completed the Peters Delusions Inventory to assess delusion proneness, as well as the Iowa Gambling Task (IGT) and the Game of Dice Task (GDT) to assess risky decision making. It was hypothesized that the more delusion prone an individual is, the riskier they will be on the IGT but not the GDT. Correlational analyses found few significant relationships between delusion proneness and decision making. Specifically, individuals higher in delusion proneness decided more advantageously on one of the five blocks of trials of the IGT. The present study has implications for the assessment of decision-making in individuals with and without a history of delusions and will give further insight into the jumping to conclusions bias within the delusion prone population.

Decision making deficits are seen across a variety of diagnosable mental health conditions, as well as in the general population. Understanding the factors that affect decision making is important, as it can provide insight into ways to improve decision making processes. One factor that could affect decision making is the presence of delusional beliefs. The present study will examine risky decision making as a function of delusion proneness, an individual differences variable existing on a continuum from no delusional beliefs to a diagnosis of delusional disorder or schizophrenia. First, the research on schizophrenia and delusions will be reviewed.

Schizophrenia

Schizophrenia is a diagnosable mental illness that disables around 1% of the population worldwide (Robertson, Hori, & Powell, 2005). Schizophrenia is a complex disorder with symptoms resulting from both environmental factors, including severe malnutrition during early stages of development, early exposure to viruses, recurrent psychological stress, and pre- and post-birth complications, and genetic factors such as being a relative of someone with the disorder (Robertson et al., 2005). According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association [APA], 2013), schizophrenia is characterized by the presence of at least one of the following: positive symptoms, which add to an individual's behavior (delusions and hallucinations), negative symptoms, that take away from their typical behavior (e.g., apathy and avolition), or disorganized symptoms, which are atypical emotional behaviors brought on by thought disturbances (disorganized thought, disorganized behavior, and catatonia).

For the present study, the focus will be on one component of schizophrenia: delusional beliefs. In addition to being one of the main positive symptoms associated with schizophrenia,

delusions are also part of several additional DSM-5 disorders, including Delusional Disorder, Brief Psychotic Disorder, Schizophreniform Disorder, and Schizoaffective Disorder (APA, 2013), as well as being present—to a lesser degree—in individuals without a diagnosable disorder. Delusions are described as imprecise thoughts and/or beliefs that continue to exist after being confronted with contradictory evidence (Peters, Joseph & Garety, 1999). Examples of common delusional beliefs are grandeur (belief one has a special ability, such as having a direct connection to an "almighty power"), erotomanic (the thought that a celebrity is incredibly in love with them), persecutory (believing someone is conspiring against them), and somatic (the belief that one's body is not functioning properly; Porcher, 2016). It is widely understood that delusions are multidimensional in character and should be measured on three separate domains: conviction (how strongly one believes in the belief), preoccupation (how much time one spends thinking about the belief), and distress (how much the belief affects a person's day-to-day life) (Peters et al., 1999). An individual can have varying levels of these domains for each delusional belief. For example, a delusion of grandeur might be high in conviction but low in preoccupation and distress, whereas the same individual's delusion of persecution might be low in conviction but high in preoccupation and distress.

Delusion Proneness

Delusions are a common component of schizophrenia, though not all individuals who experience delusions have an underlying psychiatric diagnosis. However, delusions are a main focus when evaluating and diagnosing someone with a psychotic disorder. Delusions can have a large impact on the direction of treatment for both the personal (e.g. becoming unrecognizable to yourself) and social (e.g. becoming afraid to leave the indoors due to the fear delusions may have instilled in you) components of schizophrenia (Porcher, 2016). Delusions are believed to exist on

a spectrum where delusions strong enough to be associated with psychotic disorders are at one extreme, and the complete absence of delusional thoughts or beliefs are at the other (Ho-wai So & Kwok, 2015). Existing between the two ends of the spectrum is a factor called delusion proneness, an individual-differences characteristic that can be defined by a person scoring high or low (based on a median split) on a delusion proneness measure (Peters et al., 1999). Individuals who are considered delusion-prone typically have varying extents of frequency or occurrence of delusions. For example, one individual may experience one delusion whereas another individual may experience 10 delusions. The magnitude of conviction, preoccupation, and distress of the delusion ranges from low to high in each individual as well. This shows that delusions are not necessarily "all or nothing" false beliefs, but rather beliefs that can vary on conviction, preoccupation, and distress leading to different effects on the individual's everyday life (Peters et al., 1999).

Cognition in Schizophrenia and Delusion Proneness

Cognitive impairments are a core feature of schizophrenia. Cognitive performance among individuals with schizophrenia is, on average, one standard deviation below that of healthy control participants (Lennertz et al., 2015). Impairments are found across many cognitive domains, such as attention and memory, but are most often noticed in the domain of executive functions. Executive functions are cognitive processes that allow us to function in daily life, including the capacity to plan ahead, create goals, predict outcomes of decisions made, direct attention, organize thoughts/behaviors, and manipulate information for further use (Cicerone et al., 2000). Executive functions are linked with the frontal lobe of the brain, and with the prefrontal cortex in particular (Bechara, Damasio, Tranel, & Anderson, 1998). Decision making is one of these executive functions, and is the focus of the present study.

Frontal lobe disturbances have been considered one of the main factors in schizophrenia (Jackowski et al., 2012). Computerized tomography (CT) and magnetic resonance imaging (MRI) have been used to show the frontal lobe's involvement in schizophrenia, finding that individuals with a significantly decreased frontal lobe volume show impairments on executive tasks such as the Wisconsin Card Sort (WCST), Stroop color word test, Trail Making Test (TMT), and verbal fluency (Sanz de la Torre, Barrios, & Junque, 2004). Studies using functional MRI found abnormal neuronal activation among individuals with schizophrenia was related to dysfunction in higher cognitive abilities and working memory in particular (Nygard et al., 2013).

Most cognitive declines within the executive function domain among individuals with schizophrenia are noticed in areas such as information processing, attention, working memory, verbal and visual learning (with subsequent effects on memory), reasoning and problem solving, verbal comprehension, and decision-making (Ferreri, Agbokou, & Gauthier, 2006). Tasks such as the WCST, Digital Symbol Substitution Task (DSST), Forward and Backward Digit Span (FDS & BDS), and the TMT have been used to assess executive functions in schizophrenia patients (Ochoa et al., 2014) as well as those with delusions and other delusional disorders. Results from these tasks show that participants with schizophrenia perform worse than control participants (Ochoa et al., 2014), indicating impaired executive functions associated with the disorder. Some of the same tasks (TMT, Stroop color word test, WCST) have been used to determine the impact of delusions on executive function and memory, showing that participants with delusions in schizophrenia performed worse than controls (Ibanez-Casas et al., 2013). In sum, executive impairments are seen both in schizophrenia and individuals experiencing delusions (but without a psychiatric diagnosis).

Decision Making

The process in which a choice is made when presented with multiple alternatives can be referred to as decision making (Reber, Allen, & Reber, 2009). Decision making deficits in individuals with schizophrenia have also been studied. In one study, goal-directed behavior, selecting a specific goal and making choices in order to reach that goal, was assessed by using a delay discounting task, a task in which participants are presented with choices that reward them either immediately (but are smaller) or at some point in the future (but are larger; Weller et al., 2014). The results from this study showed that individuals with schizophrenia were less willing to wait for a larger reward if it takes time to get it, instead opting for the smaller but immediate reward. Decision making under risk refers to the process of making decisions when there are known potential negative consequences associated with the decision. Decision making under risk, or risky decision making, is frequently assessed in schizophrenia patients by administering the Iowa Gambling Task (IGT; Bechara et al., 1994), Balloon Analogue Risk Task (BART; Lejuez et al., 2002), and the Game of Dice Task (GDT; Brand et al., 2005). Individuals with schizophrenia or schizoaffective disorder, a combination of schizophrenia and a mood disorder, presented scores indicating a continuous disadvantageous strategy on the IGT, where new information was not incorporated into the decision making process (e.g., Bark, Dieckmann, Bogerts, & Northoff, 2005; Brown et al., 2015; Cheng, Tang, Li, Lau, & Lee, 2012; Fond et al., 2013; Premkumar et al., 2008).

Past research indicated that people diagnosed with schizophrenia show a tendency towards what is referred to as a "jumping to conclusions" (JTC) bias (Linney, Peters, & Ayton, 1998). The JTC bias suggests that the schizophrenic individual requests less information and becomes more abrupt in making decisions. A participant with the JTC bias will utilize less information in a decision than a healthy control participant (Garety & Freeman, 1999). For

example, someone with schizophrenia who was asked to make a decision in a lab study would more quickly come to a decision, and with less requested information, than a control participant. One could even refer to this decision making process as impulsive. Across studies, the JTC bias has been seen in individuals diagnosed with schizophrenia (Moritz, Woodward, & Lambert, 2007), with the researchers theorizing this bias occurs due to executive dysfunction and impairments in the PFC (Sanz de la Torre et al, 2004). It is possible that this JTC bias could occur on other measures of decision making, such as the behavioral decision making tasks previously described.

The JTC bias has been found in delusion prone individuals as well. Researchers found individuals who are delusion prone (i.e., high delusion proneness), reach decisions much faster than those who are not (Warman, 2008). However, there is a speed-accuracy trade-off in decision making, such that making quicker decisions does not always result in more accurate (or less risky) decisions (Fitts, 1954; Payne, Bettman, & Johnson, 1992; Ratcliff, Thompson, & McKoon, 2015). In particular, delusion proneness had a negative effect on performance on the Stroop task, in that participants responded more quickly but less accurately (i.e., jumping to conclusions) on the task (Orem & Bedswell, 2010). This relationship makes sense, given the strong negative relationship between delusional thoughts and cognitive impairments (Stainsby & Loveall, 2014). However, there is very little research on delusion prone individuals and their cognitive functions to date, as most of the past research consists of examining their ability to perform decision-making tasks such as the beads task. In the beads task, participants are presented with two jars and are shown beads that have been drawn from one of the two jars. They need to guess which jar the beads came from with this limited information. Participants are then asked to make this decision based off of what they know about the color of the beads (red,

blue) and the two jars (80% blue, 20% blue) (Huq, Garety, & Hemsley, 1988). Numerous studies have shown that individuals who are delusion-prone show the JTC bias while participating in this task (Linney, Peters, & Ayton, 1998; Ho-wai So & Kwok, 2015; van der Leer & McKay, 2014) by requesting less beads to make a decision, even when monetary rewards were introduced.

The JTC bias shares common features with another factor known to influence decision making: heuristics. Heuristics are rules or guidelines that can help individuals arrive at an efficient decision (Busemeyer & Townsend, 1993; Payne, Bettman, & Johnson, 1988), but can also introduce bias (Kahneman & Tversky, 1973). Using heuristics is necessary, as they can shorten decision speed, but may lead to a less optimal decision than one made through a slower, more evaluative process. Hence, the JTC bias and heuristics both refer to making somewhat more impulsive decisions than would be optimal. Slowing down decision making speed can improve performance on some decision making tasks (e.g., Goudriaan, Oosterlaan, de Beurs, & van den Brink, 2005), whereas speeding up decision making can result in riskier performance (e.g., Buelow, Hupp, Porter, & Coleman, 2018; Cella, Dymond, Cooper, & Turnbull, 2007). Although the JTC bias has been studied in delusion proneness, it has not been studied with the same behavioral tasks as assessed in studies of schizophrenia. Thus, previous research into heuristics could be used to inform our understanding of how delusion proneness might affect decision making. But, the specific task used to assess decision making can lead to different decision making processes.

Two commonly utilized behavioral decision making tasks are the IGT and the GDT. The IGT assesses risky decision making by having participants learn through trial-and-error feedback which two decks of cards are advantageous and which two decks of cards are disadvantageous (Bechara et al., 1994). The GDT was created to remove the learning-based decision making

component of the IGT, and instead assesses risky decision making when all necessary information needed to make a decision is presented at the start of the task (Brand et al., 2005). Although no study to date has examined performance on both of these tasks in delusion proneness or schizophrenia, it is likely that the JTC bias would affect performance differently on these tasks. As individuals do not need to learn to decide advantageously on the GDT, instead just needing to utilize the already presented information to make a decision, it is likely that the JTC bias would not affect decision making on this task. But, to maximize decision making on the IGT, individuals need to utilize feedback from each decision to learn which decks are "good" and which are "bad." Failing to pay attention to the feedback, or jumping to conclusions, on the IGT will in turn result in risky performance. Thus, utilizing these two tasks allows for an examination of how JTC bias affects the decision making process in delusion prone individuals.

The Present Study

The present study sought to examine the relationship between risky decision making and those who are high and low in delusion proneness. Considering a large amount of research on decision making in delusion proneness has been conducted with the beads task, this study will instead focus on decision making on the IGT and GDT given the extensive research on these tasks in schizophrenia. Past research found that the JTC bias results from a data gathering deficit, where individuals high in delusion proneness will acquire less information throughout the task leading to a worse outcome. Several hypotheses will be tested. First, individuals reporting higher levels of delusion proneness will be riskier on the IGT (i.e., select more from the disadvantageous decks as the task progresses) than individuals reporting lower levels of delusion proneness, due to a data gathering deficit on this learning-based decision making task. This difference was not hypothesized for the GDT, as no learning occurs over the course of this task.

It was also hypothesized that levels of conviction would be correlated with performance on the IGT but not the GDT, given the previous research showing a relationship between conviction and the JTC bias. No hypothesis was made for preoccupation or distress, as these have received less attention in the literature. We consider these final analyses exploratory.

Methods

Participants

Prior to the start of the in-person study, an online screening was administered to assess for levels of delusion proneness. A total of 424 undergraduate student participants at OSU Newark, ages 18-60 (M_{age} = 18.85, SD_{age} = 3.23, 154 males), completed the online screening and received course credit for their participation. Of those, 76 (23 males, ages 18-23 [M_{age} = 18.44, SD_{age} = 0.84], 67.6% Caucasian) chose to also complete the in-person study assessing decision making.

Procedure

The university's Institutional Review Board approved the present study. Prior to participating in the online and in-lab sessions of the study, participants gave informed consent. During the online session, participants completed the PDI and provided basic demographic information. Any participant that completed the online study could then decide to sign-up for the in-person follow-up study. During the in-person study, participants completed the IGT and GDT in a counterbalanced order. At the end of each session, participants were debriefed and course credit was assigned.

Measures

Peters Delusions Inventory (PDI). The PDI was created to measure delusion proneness in a non-psychiatric population (Peters et al., 1999). This questionnaire contains items developed

to examine the intensity of delusions and their components (conviction, preoccupation, and distress; Peters et al., 1999). The 40-items assess level of delusion proneness with responses to four questions per item. Participants first responded "yes" or "no" to the particular delusion presented. If the participant responded "yes," then they rated their conviction, preoccupation, and distress with that delusion on a scale from 1 (*not at all*) to 5 (*very)*. An example item from the questionnaire is, "Do you ever feel as if the world is about to end?" To assess level of delusion proneness, a total score was calculated that ranged from 0 (no delusion proneness) to 40 (significant delusion proneness). For conviction, preoccupation, and distress, an average score was calculated for each subscale such that higher scores indicated higher levels of the factors. The mean score for the participants who completed the in-person portion of the study was 10.11 (Median = 10). For the participants who only completed the online-screening portion of the study, the mean score was 9.44 (Median = 8).

Game of Dice Task (GDT). The GDT, a computerized task that assesses risky decision making, is a simulation of a real-life gambling situation (Brand et al., 2005). Participants are given directions to maximize their profit by rolling a virtual die 18 times. Before each roll of the die, participants choose a single number or combination of up to four numbers, with each selection having a preset gain/loss amount associated with it. Making a selection of a single number provides the potential for the greatest profit but also the greatest loss ($1000). Selecting a combination of 4 numbers will provide a lesser gain or loss ($100). The present study used selections of 1, 2, 3, and 4 numbers to calculate a net score to assess risky decision making. The net score was calculated by subtracting the number of risky choices made (selections of 1 or 2 numbers) from the number of less risky choices (selections of 3 or 4 numbers). Higher numbers indicated more advantageous (i.e., less risky) decision making.

Iowa Gambling Task (IGT). The standard computerized version of the IGT was administered to all participants to assess level of risky decision making (Bechara, 2007). At the beginning of the game, participants are given a loan of $2,000. Instructions were given to maximize their amount of profit by the end of the game. Four decks (Decks A, B, C, and D) are presented to the participants. Decks A and B produce an average profit of $100 for each selection, and Decks C and D produce an average profit of $50 for each selection. Decks A and C yield losses on fifty percent of their trials and ten percent of trials for Decks B and D. After making 10 selections from Decks A and B, participants have accrued a net loss of $250, when participants who have made 10 selections from Decks C and D have accrued a net gain of $250 (Bechara et al. 1994). Decks A and B are considered to be disadvantageous decks, deeming selections from them as risky, leaving Decks C and D to be considered advantageous decks (Bechara et al. 1994). Decks are considered to be advantageous or disadvantageous based on the amount gained verses the amount lost from the selection of each deck. In addition, the type of decision making assessed on the IGT changes as the task progresses. Early selections are made under ambiguity, as participants have not learned much about the relative risks and benefits of the decks. After approximately 40 trials, however, the IGT instead begins to assess decision making under risk. Participants are now making decisions based on prior feedback, and have at least a general sense of the relative risks and benefits of selections from each deck. For the present study, scores were calculated by subtracting the total of disadvantageous choices from the advantageous ones by 20-card blocks of trials (Block 1: Trials 1-20; Block 2: Trials 21-40; Block 3: Trials 41-60; Block 4: Trials 61-80; Block 5: Trials 81-100). More positive values indicated more advantageous decision making.

Data Analysis

To assess the first hypothesis that individuals reporting higher levels of delusion proneness would be riskier on the IGT but not the GDT, two analyses were conducted. First, Pearson's correlations were conducted between level of delusion proneness and performance on the IGT and GDT. In addition, a mixed ANOVA with IGT Block as a repeated-measures variable and median split (high, low) as the between-subjects variable was calculated, per the scoring criteria from Peters et al. (1999). An independent-samples *t*-test examined the PDI median split on the GDT. To assess the second hypothesis that level of conviction would be correlated with performance on the IGT but not the GDT, correlations were also calculated between levels of conviction, preoccupation, and distress and performance on the IGT and GDT.

Results

Table 1 contains the variable means and standard deviations, and Table 2 contains the correlations between study variables. Two participants were removed from the analyses, as examination of their patterns of performance on the IGT indicated previous experience with the task (i.e., first 20 selections from the same deck). Of note, computer malfunction led to the loss of some data on the IGT, lowering the degrees of freedom on the remaining analyses.

Correlational analyses showed no significant relationship between delusion proneness total score and performance on Block 1 ($p = .724$), Block 2 ($p = .107$), Block 3 ($p = .139$), and Block 5 ($p = .726$) of the IGT. On Block 4, individuals high in delusion proneness decided more advantageously than individuals low in delusion proneness, $p = .038$. There was not a significant relationship between delusion proneness and the GDT, $p = .231$. With regard to conviction, distress, and preoccupation, none of these factors was associated with performance on the GDT (ps > .442) or IGT (ps > 1.58).

Next, a median split was calculated on the delusion proneness total score, as recommended by the PDI creators. The median score was 10 out of a possible 40, and the variable was recoded as 1 (*below median*) and 2 (*above median*). The mixed ANOVA indicated a main effect of Block, $F(4,56) = 4.64$, $p = .003$, partial $\eta^2 = .249$, and the main effect of median split group was significant, $F(1,59) = 4.69$, $p = .034$, partial $\eta^2 = .074$. However, the main effects will not be interpreted as the interaction was significant, $F(4,56) = 2.91$, $p = .029$, partial $\eta^2 = .172$. In Block 1 ($p = .667$) and Block 2 ($p = .166$), no differences emerged between groups. On Blocks 3 ($p = .021$) and 4 ($p = .004$), participants who scored above the median split (i.e., higher in delusion proneness) selected more advantageously than participants scoring below the median split on the PDI. In Block 5, no differences emerged ($p = .615$). No significant differences emerged between groups on the GDT, $t(68) = -0.12$, $p = .908$.

Discussion

The present study examined the relationship between risky decision making and delusion proneness, as most research on risky decision making to date focused instead on individuals with a diagnosis of schizophrenia. In addition, the subcomponents of delusion proneness (conviction, distress, preoccupation) were also examined. The present study also utilized the IGT and GDT, tasks not typically assessed in previous studies of delusion proneness. Limited support was found for the first hypothesis, that participants scoring higher in delusion proneness would be riskier on the IGT (but not the GDT) than individuals scoring lower in delusion proneness. The results indicated no relationship between total delusions on the PDI and performance on the GDT. On the GDT, participants are told explicitly at the start of the task how much money they could win or lose based on a particular decision. No information needed to be "discovered" during the task, and thus it was likely the jumping to conclusions bias would not be in play during this task.

However, on the IGT only one significant correlation emerged. Contrary to our hypothesis, on Block 4, during the decision making under risk trials, individuals high in delusion proneness actually decided more advantageously than individuals low in delusion proneness. Although the IGT has not been previously examined with a sample high in delusion proneness, this finding is contrary to previous research in schizophrenia (Bark et al., 2005; Brown et al., 2015; Cheng et al., 2012; Premkumar et al., 2008). In addition, it is unclear why this significant finding only occurred on Block 4, as Blocks 3 and 5 also are considered decision making under risk trials. That said, the exploratory median split analyses indicated a group difference on Blocks 3 and 4, and this finding is important for future research to examine.

Additional hypotheses and study aims were tested. The second hypothesis tested was that level of conviction would be correlated with IGT scores. No support was found for this hypothesis, as no correlations emerged between performance on the IGT (or GDT) and level of conviction related to delusions. Finally, potential relationships between distress, preoccupation, and decision making were examined, with no significant results found on either the IGT or GDT.

These results were surprising given the body of previous research that showed contradictory evidence. Most research on delusion proneness, though limited mainly to performance on a probabilistic classification task, found a jumping to conclusions bias among delusion prone individuals (Garety, Hemsley & Wessely, 1991; Huq et al., 1988), suggesting impaired decision making at least to some degree. But, some studies found the opposite: delusion prone individuals actually performed better than the non-delusion prone participants (Freeman, Pugh, Vorontsova, Antley & Slater, 2010; Warman, Lysaker, Martin, Davis & Haudenschield, 2007). These authors purposed that it is possible that high delusion prone individuals adjust their data gathering abilities to the type of task at hand. For example, they would expend greater

resources on a harder than an easier task. This assumption may be applicable within the results of the present study, as the nature of the IGT and lack of instructions at the start of the task might make it a harder task.

The results from the present study indicate that the JTC bias is not present during risky decision making tasks such as the IGT and GDT. The majority of the previous research has used the beads task, a probabilistic task in which the difficulty level can be adjusted (Garety et al., 1991). Garety et al. (1991) found that when the beads task is made more difficult, delusion prone individuals tend to require more information to make a decision, in turn making their performance comparable to non-delusion prone individuals. It has also been shown that the typical amount of trials performed during the beads task ranges from 5 to 10 (van der Leer et al., 2017; van der Leer et al., 2014; Warman, 2008). The IGT spans over 100 trials, significantly more than the 5 to 10 trials performed during the beads task. This gives the implication that participants recognize the lack of simplicity within the IGT, initiating a response to try harder. Another factor that may have affected performance on the IGT was the amount of direction given in the beginning of the task. In the beads task, there are specific directions given on how the task works. The IGT on the other hand is very ambiguous with directions, participants are required to learn the rules of the task as they perform it. The ambiguity of the task may have enhanced the perceived level of difficulty for the participants. Taken together, it is possible that nuances of the IGT itself led to its interpretation by participants as a harder task requiring greater effort and attention to detail, in turn "normalizing" performance on the task among delusion prone individuals.

Limitations

The present study had several limitations. First, the body of participants from which the data was drawn from could be a potential limitation. The participants were undergraduate students, who are commonly participants in studies of the IGT and GDT. Steingroever and Wetzels (2012) concluded that the body of research performed with the IGT and within undergraduate student participants has shown a wide range of scores, due in part to issues with lack of motivation from the participants. Considering the students participating in the study had nothing to gain from the completing the IGT, a lack of motivation may have been present in some individuals. That said, previous research has shown no differences in performance on the IGT when participants are informed in advance they will be paid for their participation (Bevelhymer-Rangel, 2013). Another limitation of the present study would be the sample size (n=74). This is a relatively small amount of participants and could account for the variability within the results. Future research should include a much larger sample. As the sample came from a group of undergraduate students, it is possible there was a restriction of range for the PDI scores. The PDI scores in the present study ranged from 0-28 (out of a possible score of 40), with a mean score of 10.19. It is possible that a sample of community members with a wider range of PDI scores (and higher mean score) would show a different relationship with decision making task performance. Finally, the present results may be due in part to a speed-accuracy trade-off. Participants may have slowed down the decision making process to arrive at the "correct" answer, in turn equalizing performance on the task by level of delusion proneness. Unfortunately, data on decision making speed was not collected for all participants, making analysis of this question difficult in the already small sample.

Conclusion

This study was the first to assess risky decision making as a function of delusion proneness with the IGT and the GDT. The results indicated few relationships between delusion proneness and performance on these risky decision making tasks. These results show the need for future studies to investigate decision making and delusion proneness further, as the small sample size could have affected results. One aspect that should be further studied is delusion prone individuals' ability to adjust the amount of data they gather in respect to the level of perceived difficulty of the task. Future research utilizing both easy and hard tasks in the same study will help elucidate this data gathering deficit in delusion proneness.

References

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders (5th edition)*. Washington, DC: American Psychiatric Association.

Bark, R., Dieckmann, S., Bogerts, B., & Northoff, G. (2005). Deficit in decision making in catatonic schizophrenia: An exploratory study. *Psychiatry Research, 134*(2), 131-141.

Bechara, A. (2007). *Iowa gambling task professional manual*. Lutz, FL: Psychological Assessment Resources Inc.

Bechara, A., Damasio, H., Tranel, D., & Anderson, S.W. (1998). Dissociation of working memory from decision making within the human prefrontal cortex. *The Journal of Neuroscience, 18*, 428-437.

Bevelhymer Rangel, K. (2013). Improving decision making. Unpublished thesis project.

Brand, M., Kalbe, E., Labudda, K., Fujiwara, E., Kessler, J., & Markowitsch, H.J. (2005). Decision-making impairments in patients with pathological gambling. *Psychiatry Research, 133*, 91-99.

Brown, E.C., Hack, S.M., Gold, J.M., Carpenter, W.T., Fischer, B.A., Prentice, K.P., & Waltz, J.A. (2015). Integrating frequency and magnitude information in decision-making in schizophrenia: An account of patient performance on the Iowa gambling task. *Journal of Psychiatric Research. 66*, 16-23.

Buelow, M.T., Hupp, J.M., Porter, B., & Coleman, C. (2018). The effect of prosody on decision making: Speech rate influences speed and quality of decisions. Manuscript under review.

Busemeyer, J.R., & Townsend, J.T. (1993). Decision field theory: A dynamic-cognitive approach to decision making in an uncertain environment. *Psychological Review, 100*, 432-459.

Cella, M., Dymond, S., Cooper, A., & Turnbull, O. (2007). Effects of decision-phase time constraints on emotion-based learning in the Iowa gambling task. *Brain and Cognition, 64*, 164-169. doi: 10.1016/j.bandc.2007.02.003

Cheng G.F., Tang J.Y., Li, F.S., Lau, E.Y., & Lee T.C. (2012). Schizophrenia and risk-taking: Impaired reward but preserved punishment processing. *Schizophrenia Research, 136*, 122-127.

Cicerone, K. D., Dahlberg, C., Kalmar, K., Langenbahn, D. M., Malec, J. F., Bergquist, T. F., *et al.* (2000). Evidence-based cognitive rehabilitation: Recommendations for clinical practice. *Archives of Physical Medicine and Rehabilitation, 81*, 1596–1615.

David, A.S. (2010). Why we need more debate on whether psychotic symptoms lie on a continuum with normality. *Psychological Medicine, 40*(12), 1935-1942.

Ferreri, F., Agbokou, C., & Gauthier, S. (2006). Cognitive dysfuctions in schizophrenia: Potential benefits of cholinesterase inhibitor adjunctive therapy. *Journal of Psychiatry & Neuroscience, 31*(6), 369-376.

Fitts, P.M. (1954). The information capacity of the human motor system in controlling the amplitude of movement. *Journal of Experimental Psychology, 47*, 381-391.

Fond, G., Bayard, S., Capdevielle, D., Del-Monte, J., Mimoun, N., Macgregor, A., & ... Raffard, S. (2013). A further evaluation of decision-making under risk and under ambiguity in schizophrenia. *European Archives of Psychiatry and Clinical Neuroscience, 263*(3), 249-257.

Freeman, D., Pugh, K., Vorontsova, N., Antley, A., & Slater, M. (2010). Testing the continuum of delusional beliefs: An experimental study using virtual reality. *Journal of Abnormal Psychology, 119*(1), 83-92.

Garety P. A., & Freeman D. (1999). Cognitive approaches to delusions: A critical review of theories and evidence. British Journal of Clinical Psychology, *38*, 113–154.

Garety, P.A., Hemsley, D.R., & Wessely, S. (1991). Reasoning in deluded schizophrenic and paranoid patients: Biases in performance on a probabilistic inference task. *Journal of Nervous and Mental Disease*, *179*(4), 194-201.

Goudriaan, A.E., Oosterlaan, J., de Beurs, E., & van den Brink, W. (2005). Decision making in pathological gambling: A comparison between pathological gamblers, alcohol dependents, persons with Tourette syndrome, and normal controls. *Cognitive Brain Research*, *23*(1), 137-151.

Ho-wai So, S., & Kwok, N.T. (2015). Jumping to conclusions style along the continuum of delusions: Delusion-prone individuals are not hastier in decision making than healthy individuals. *Plos One*, 10(3).

Huq, S. F., Garety, P. A., & Hemsley, D. R. (1988). Probabilistic judgements in deluded and nondeluded subjects. *Quarterly Journal of Experimental Psychology, 40A*, 801–812.

Ibanez-Casas, I., De Portugal, E., Gonzalez, N., McKenney, K. A., Haro, J. M., Usall, J., & ... Cervilla, J. A. (2013). Deficits in executive and memory processes in delusional disorder: A case-control study. *Plos ONE*, *8*(7)

Jackowski, A.P., de Araújo Filho, G.M., de Almeida, A.G., de Araújo, C.M., Reis, M., Nery, F., & ... Lacerda, A.T. (2012). The involvement of the orbitofrontal cortex in psychiatric disorders: An update of neuroimaging findings. *Revista Brasileira De Psiquiatria*, *34*(2), 207-212.

Kahneman, D., & Tversky, A. (1973). On the psychology of prediction. *Psychological Review, 80*, 237-251.

Lejuez, C.W., Read, J.P., Kahler, C.W., Richards, J.B., Ramsey, S.E., . . . & Brown, R.A. (2002). Evaluation of a behavioral measure of risk taking: The balloon analogue risk task (BART). *Journal of Experimental Psychology: Applied, 8,* 75-84.

Lennertz, L., an der Heiden, W., Kronacher, R., Schulze-Rauschenbach, S., Maier, W., Häfner, H., & Wagner, M. (2016). Smaller than expected cognitive deficits in schizophrenia patients from the population-representative ABC catchment cohort. *European Archives of Psychiatry And Clinical Neuroscience, 266*(5), 423-431.

Linney, Y.M., Peters, E.R., & Ayton, P. (1998). Reasoning biases in delusion-prone individuals. *British Journal of Clinical Psychology, 37,* 285-302.

Moritz, S., Mayer-Stassfurth, H., Endlich, L., Andreou, C., Ramdani, N., Petermann, F., & Balzan, R. P. (2015). The Benefits of Doubt: Cognitive bias correction reduces hasty decision-making in schizophrenia. *Cognitive Therapy and Research, 39*(5), 627-635.

Nygård, M., Løberg, E., Craven, A.R., Ersland, L., Berle, J.Ø., Kroken, R.A., & ... Hugdahl, K. (2013). Dichotic listening, executive functions and grey matter cortical volume in patients with schizophrenia and healthy controls. *Scandinavian Journal of Psychology, 54*(6), 443-450

Ochoa, S., Haro, J.M., Huerta-Ramos, E., Cuevas-Esteban, J., Stephan-Otto, C., Usall, J., & ... Brebion, G. (2014). Relation between jumping to conclusions and cognitive functioning in people with schizophrenia in contrast with healthy participants. *Schizophrenia Research, 159*(1), 211-217.

Orem, D.M., & Bedwell, J.S. (2010). A preliminary investigation on the relationship between color-word stroop task performance and delusion-proneness in nonpsychiatric adults. *Psychiatry Research, 175*(1-2), 27-32.

Payne, J.W., Bettman, J.R., & Johnson, E.J. (1988). Adaptive strategy selection in decision making. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 14*, 534-552.

Payne, J.W., Bettman, J.R., & Johnson, E.J. (1992). Behavioral decision research: A constructive processing perspective. *Annual Review of Psychology, 43*, 87-131.

Pedersen, A., Göder, R., Tomczyk, S., & Ohrmann, P. (2017). Risky decision-making under risk in schizophrenia: A deliberate choice?. *Journal of Behavior Therapy and Experimental Psychiatry, 56*, 57-64.

Peters, E.R., Joseph, S.A., & Garety, P.A. (1999). Measurement of delusional ideation in the normal population: Introducing the PDI (Peters et al. Delusions inventory). *Schizophrenia Bulletin, 25*(3), 553-576.

Porcher, J.E. (2016). The classification, definition, and ontology of delusion. *Revista Latinoamericana De Psicopatologia Fundamental, 19*(1), 167-181.

Premkumar, P., Fannon, D., Kuipers, E., Simmons, A., Frangou, S., & Kumari, V. (2008). Emotional decision-making and its dissociable components in schizophrenia and schizoaffective disorder: A behavioural and MRI investigation. *Neuropsychologia, 46*, 7-10.

Ratcliff, R., Thompson, C.A., & McKoon, G. (2015). Modeling individual differences in response time and accuracy in numeracy. Cognition, 137, 115-136.

Reber, A. S., Allen, R., Reber, E. S. (2009). *Penguin dictionary of psychology* (4th ed.). London, UK: Penguin.

Robertson, G.S., Hori, S.E., & Powell, K.J. (2006). Schizophrenia: An integrative approach to modelling a complex disorder. *Journal of Psychiatry & Neuroscience, 31*(3), 157-167.

Sanz de la Torre, J.C., Barrios, M., & Junqué, C. (2005). Frontal lobe alterations in schizophrenia: Neuroimaging and neuropsychological findings. *European Archives of Psychiatry and Clinical Neuroscience, 255*(4), 236-244.

Schmack, K., de Castro, A.G., Rothkirch, M., Sekutowicz, M., Rössler, H., Haynes, J., & Sterzer, P. (2013). Delusions and the role of beliefs in perceptual inference. *The Journal of Neuroscience, 33*(34), 13701-13712.

Stainsby, L.M., & Lovell, G.P. (2014). Proneness to hallucinations and delusions in a non clinical sample: Exploring associations with metacognition and negative affect. *Australian Journal of Psychology, 66*(1), 1-7.

Steingroever, H., Wetzels, R., Horstmann, A., Neumann, J., & Wagenmakers, E.J. (2013). Performance of healthy participants on the Iowa Gambling Task. *Psychological Assessment, 25,* 80-93.

van der Leer, L., & Mckay, R. (2014). Jumping to conclusions in delusion-prone participants: An experimental economics approach. *Cognitive Neuropsychiatry, 19*(3), 257-267.

van der Leer, L., Hartig, B., Goldmanis, M., & McKay, R. (2017). Why do delusion-prone individuals "jump to conclusions?" An investigation using a nonserial data-gathering paradigm. *Clinical Psychological Science, 5*(4), 718-725.

Warman, D.M. (2008). Reasoning and delusion proneness confidence in decisions. *The Journal of Nervous and Mental Disease, 196*(1), 9-15.

Warman, D. M., Lysaker, P. H., Martin, J. M., Davis, L., & Haudenschield, S. L. (2007). Jumping to conclusions and the continuum of delusional beliefs. *Behaviour Research and Therapy, 45*(6), 1255-1269.

Weller, R. E., Avsar, K. B., Cox, J. E., Reid, M. A., White, D. M., & Lahti, A. C. (2014). Delay discounting and task performance consistency in patients with schizophrenia. *Psychiatry Research, 215*, 286–293.

Table 1.

Means and standard deviations

Variable	Mean	Standard Deviation	Range
PDI			
Total Score	10.19	6.79	0-28
Conviction	2.62	0.87	1-5
Distress	2.45	0.90	1-5
Preoccupation	2.55	0.87	1-5
IGT 1-20	-3.10	5.39	-18-10
IGT 21-40	-0.19	6.06	-18-20
IGT 41-60	-0.44	7.07	-20-20
IGT 61-80	1.23	7.13	-18-20
IGT 81-100	1.61	7.91	-20-20
GDT	4.06	10.43	-18-18

Note: PDI = Peters Delusion Inventory; IGT = Iowa Gambling Task, advantageous minus disadvantageous selections by 20-card blocks of trials; GDT = Game of Dice Task, advantageous minus disadvantageous selections.

Table 2.

Correlations between study variables

	1	2	3	4	5	6
1. DP-t	--	.353**	.228	.373**	.046	.208
2. DP-c		--	.776***	.917***	.062	.087
3. DP-d			--	.855***	.048	.189
4. DP-p				--	.049	.129
5. IGT 1					--	-.119
6. IGT 2						--
7. IGT 3						
8. IGT 4						
9. IGT 5						
10. GDT						

*p<.05; **p<.01; ***p<.001

Note: PDI = Peters Delusion Inventory (c = conviction, d = distress; p = preoccupation); IGT = Iowa Gambling Task, advantageous minus disadvantageous selections by 20-card blocks of trials; GDT = Game of Dice Task, advantageous minus disadvantageous selections.

	7	8	9	10
1. DP-t	.192	.267*	.046	-.120
2. DP-c	-.181	-.072	.050	-.062
3. DP-d	-.119	-.026	.056	-.097
4. DP-p	-.068	.020	.101	-.032
5. IGT 1	-.015	.044	-.215	-.127
6. IGT 2	.583***	.527***	.267*	.243
7. IGT 3	--	.734***	.307*	.410**
8. IGT 4		--	.534***	.278*
9. IGT 5			--	-.018
10. GDT				--

Appendix A: Peters Delusion Inventory

This questionnaire is designed to measure beliefs and vivid mental experiences. We believe that they are much more common than has previously been supposed, and that most people have had some such experiences during their lives. Please answer the following questions as honestly as you can. There are no right or wrong answers, and there are no trick questions. Please note that we are NOT interested in experiences people may have had when under the influence of drugs.

For the questions you answer YES to, we are interested in: a) how distressing these beliefs or experiences are; b) how often you think about them; and c) how true you believe them to be.

1. Do you ever feel as if you are under the control of some force or power other than yourself?

No _____ Yes _____

1 2 3 4 5
Not at all distressing Very distressing
1 2 3 4 5
Hardly ever think about it Think about it all the time
1 2 3 4 5
Don't believe it's true Believe it is absolutely true

2. Do you ever feel as if you are a robot or zombie without a will of your own?

No _____ Yes _____

1 2 3 4 5
Not at all distressing Very distressing
1 2 3 4 5
Hardly ever think about it Think about it all the time
1 2 3 4 5
Don't believe it's true Believe it is absolutely true

3. Do you ever feel as if you are possessed by someone or something else?

No _____ Yes _____

1 2 3 4 5
Not at all distressing Very distressing
1 2 3 4 5
Hardly ever think about it Think about it all the time
1 2 3 4 5
Don't believe it's true Believe it is absolutely true

4. Do you ever feel as if your feelings or actions are not under your control?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

5. Do you ever feel as if someone or something is playing games with your mind?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

6. Do you ever feel as if people seem to drop hints about you or say things with a double meaning?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

7. Do you ever feel as if things in magazines or on TV were written especially for you?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

8. Do you ever think that everyone is gossiping about you?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

9. Do you ever feel as if some people are not what they seem to be?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

10. Do things around you ever feel unreal, as though it was all part of an experiment?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

11. Do you ever feel as if someone is deliberately trying to harm you?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

12. Do you ever feel as if you are being persecuted in some way?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

13. Do you ever feel as if there is a conspiracy against you?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

14. Do you ever feel as if some organization or institution has it in for you?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

15. Do you ever feel as if someone or something is watching you?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

16. Do you ever feel as if you have special abilities or powers?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

17. Do you ever feel as if there is a special purpose or mission in your life?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

18. Do you ever feel as if there is a mysterious power working for the good of the world?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

19. Do you ever feel as if you are destined to be someone very important?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

20. Do you ever feel that you are a very special or unusual person?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

21. Do you ever feel that you are especially close to God?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

22. Do you ever think that people can communicate telepathically?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

23. Do you ever feel as if electrical devices such as computers can influence the way you think?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

24. Do you ever feel as if there are forces around you which affect you in strange ways?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

25. Do you ever feel as if you have been chosen by God in some way?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

26. Do you believe in the power of witchcraft, voodoo, or the occult?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

27. Are you often worried that your partner may be unfaithful?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

28. Do you ever think that you smell very unusual to other people?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

29. Do you ever feel as if your body is changing in a peculiar way?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

30. Do you ever think that strangers want to have sex with you?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

31. Do you ever feel that you have sinned more than the average person?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

32. Do you ever feel that people look at you oddly because of your appearance?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

33. Do you ever feel as if you had no thoughts in your head at all?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

34. Do you ever feel as if your insides might be rotting?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

35. Do you ever feel as if the world is about to end?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

36. Do your thoughts ever feel alien to you in some way?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

37. Have your thoughts ever been so vivid that you were worried other people would hear them?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

38. Do you ever feel as if your own thoughts were being echoed back to you?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

39. Do you ever feel as if your thoughts were blocked by someone or something else?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

40. Do you ever feel as if other people can read your mind?

No _____ Yes _____

1	2	3	4	5
Not at all distressing				Very distressing
1	2	3	4	5
Hardly ever think about it				Think about it all the time
1	2	3	4	5
Don't believe it's true				Believe it is absolutely true

Appendix B: Iowa Gambling Task Instructions

In front of you on the screen there are four decks of cards: A, B, C, and D. I want you to select one card at a time by clicking on the card from any deck you would like. Each time you select a card, the computer will tell you that you won some money. I don't know how much money you will win. You will find out as you go along. Every time you win, the green bar will get bigger. Every so often, however, when you click on a card, the computer tells you that you have won some money, but also that you have lost some money. I don't know when you will lose or how much you will lose. You will find out as you go along. Every time you lose, the green bar gets smaller.

You are free to switch from one deck of cards to another at any time, as often as you wish. The goal of the game is to win as much money as possible, and if you can't win money, the goal is to avoid losing as much money as possible. You won't know when the game will end. Just keep playing until the computer stops. The computer is giving you $2000 credit to start the game. The red bar is a reminder of how much money you borrowed to play the game and how much money you have to pay back before we see how much money you won or lost.

It is important to know that, just like in a real card game, the computer does not change the order of the cards after the game starts. You may not be able to figure out exactly when you will lose money, but the game is fair. The computer does not make you lose money at random, or make you lose money based on the last card you picked. Also, each deck contains an equal number of cards of each color, so the color of the cards does not tell you which decks are better in this game. So you must not try to figure out what the computer is doing. All I can say is that some decks are worse than others. No matter how much you find yourself losing, you can still win if you stay away from the worst decks. Please treat the play money in this game as real money, and make all decisions about what to do with it as if you were using your own money.

Appendix C: Game of Dice Task Instructions

Welcome to the Game of Dice Task.
In this task, you are going to throw a virtual dice 18 times. Before each throw, you will be able to bet on the outcome by selecting a single number (e.g., '3') or combination of 2 to 4 numbers (e.g., '1-2-3').
The amount of money that can be won or lost differs between these combinations.
You are given a starting capital of 1000 $. Your job is to maximize this capital within 18 throws of the dice.
Good luck!

Appendix D: Demographic Questionnaire

1. Age: _____
2. Educational Level:
   - First year college _____ Fourth year college _____
   - Second year college _____ Fifth year college _____
   - Third year college _____ Other: _____
3. Major: _____
4. Current GPA: _____
5. What sex were you assigned at birth, on your original birth certificate:
   - Male _____ Female _____
6. What is your current gender identity?
   - Male _____ Female _____
   - Trans male _____ Trans female _____
   - Genderqueer/Gender non-conforming _____
   - Different identity _____
7. Please indicate your racial/ethnic background:
   - Caucasian _____ Asian American/Pacific Islander _____
   - African American _____ Asian _____
   - African _____ American Indian/Alaskan Native _____
   - Hispanic/Latino _____ Biracial/multiracial _____
   - Other _____
8. What language do you speak as your native language? _____
9. Marital Status:
   - Single _____ Married _____
   - Divorced _____ Widowed _____
   - Other: _____
10. Political Affiliation:
    - Democrat _____ Republican _____
    - Independent _____ Other: _____
11. Have you ever received a diagnosis of Attention-Deficit/Hyperactivity Disorder (ADHD) or Attention-Deficit Disorder (ADD)?
    - Yes _____ (Age diagnosed: ____) No _____
    - *If Yes*, subtype: Inattentive _____
    - Hyperactive _____
    - Combined _____
12. Who diagnosed you with ADHD or ADD?
    - Physician (MD) _____
    - Psychologist (PhD) _____
    - Psychiatrist (MD) _____
    - School Counselor or Psychologist _____
    - Other (please specify): _____
13. Have you ever received a diagnosis of a Learning Disorder (LD), such as a Reading Disorder, Writing Disorder, or Math Disorder?
    - Yes _____ (Age diagnosed: ____) No _____